ED997-0010

Issue 3, Revision 1
26 February 1996

OPERATING AND MAINTENANCE MANUAL

DRA-707 RADIO ALTIMETER RAMP SIMULATOR

ATLANTIS AEROSPACE CORPORATION

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REVISION CONTROL FORM

DRA-707 Radio Altimeter Ramp Simulator
Operating and Maintenance Manual

ED997-00108

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Revision levels of the pages in this document are as follows:

Page	Iss./Rev.	Date	Page	Iss./Rev.	Date
i - vii	3	8 Jul 91			
1-1 - 4-4	3	8 Jul 91			
4-5	3/1	26 Feb 96			
4-6 - 4-8	3	8 Jul 91			
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Section 1

INTRODUCTION

The Atlantis DRA-707 Radio Altimeter Ramp Simulator is designed to provide ground simulation of aircraft radio altitude information (in accordance with ARINC characteristic 707) in a flight-line environment. Operator-programmed altitude "ramps", along with error and fault controls, generate simulated information to drive the radio altitude buses of up to three digital radio altimeters in an aircraft. The DRA-707 may be used whenever active control of the radio altitude bus is a test requirement.

1.1 ABOUT THIS MANUAL

This manual explains how to operate and maintain the DRA-707 Radio Altimeter Ramp Simulator.

Section 1 introduces the DRA-707, describes the contents of this manual, and covers safety precautions and warranty information.

Section 2 provides a technical description of the unit and presents its physical and electrical specifications.

Section 3 includes all information necessary to set up and operate the DRA-707. It introduces the unit's controls and indicators and presents typical operating procedures.

Section 4 provides all information needed to maintain the DRA-707, including procedures for preventive periodic maintenance as well as information for troubleshooting, repair, and adjustment. Section 4 also contains schematic diagrams of the DRA-707 and its accessories.

Section 5 contains information on procedures for storing and shipping the unit, should this become necessary.

Section 6 contains a parts list of all user-replaceable components.

Appendix A contains sample ramps, and Appendix B contains the stored ramps record sheets, used for recording the programmable ramps.

1.2 SAFETY PRECAUTIONS

Specific safety warnings are provided throughout this manual as appropriate. WARNINGS are used to indicate actions that could pose safety hazards to personnel. CAUTIONS are used to indicate actions that may result in damage to equipment.

1.3 WARRANTY

All Atlantis products are warranted to be free from defects in material and workmanship for a period of one year from the date of shipment. During this period, defective products returned to Atlantis prepaid will be repaired or replaced at Atlantis' option without charge for parts, labour, or return shipping.

This warranty does not cover defects caused by abuse, improper operation, or damage incurred in shipping.

Atlantis' policy is one of continuous improvement and we reserve the right to make changes in the design of our products without incurring any responsibility to incorporate these changes into products already manufactured.

The obligations and liabilities of Atlantis Aerospace Corporation are limited to those set forth in the preceding paragraphs. No other warranties are either expressed or implied.

For help with any aspect of the use or performance of the DRA-707 Radio Altimeter Ramp Simulator, call the Atlantis Customer Support Department, (416) 792-1981.

Section 2

TECHNICAL INFORMATION

2.1 GENERAL DESCRIPTION

The Atlantis DRA-707 Radio Altimeter Ramp Simulator uses operator-defined parameters such as START ALTITUDE, STOP ALTITUDE, and VERTICAL SPEED to define a radio altitude ramp. This ramp is transmitted in digital form to up to three Collins LRA-700 radio altimeters in an aircraft. The DRA-707 is connected to the front test connectors of the aircraft's altimeter by a cable adapter. The altimeter converts the digital signal from the DRA-707 to ARINC 429 format and drives the aircraft bus when it is forced into the simulation mode by the AFCS Discrete line. Alternatively, the DRA-707 can drive the aircraft bus directly, using its own ARINC 429 output.

The DRA-707 can be operated from any convenient location, but it is designed to be used in the cockpit area. The basic 20-foot output cable used to connect the DRA-707 to the radio altimeters can be extended if necessary.

2.1.1 Outputs

The DRA-707 outputs three channels of radio altitude information, with two formats available for each channel. One is the TTL-level 1 and 0 digital data streams (plus discrete) required to drive the Collins LRA-700 radio altimeters. The other is an ARINC 429 ternary output to drive the aircraft bus directly.

2.1.2 Accessories

A hand-held remote control unit allows remote control of selected unit functions and individual system faults.

An analogue adapter is available to convert the digital word outputs of the DRA-707 to the analogue signals required for testing and/or simulation of many analogue radio altimeter systems.

The following cables and accessories are also available:

- Interface cable for the Collins LRA-700 radio altimeter triplex installation.
- 50-foot extension cable, common to all radio altimeter types (and aircraft bus-direct).
- Remote Control Unit on a 20-foot cable.
- Power cords.

2.2 PHYSICAL DESCRIPTION

The DRA-707 is housed in a portable, weather-resistant case measuring approximately 19-1/2 by 9-1/2 by 13-1/2 inches when closed. The electronics are completely housed in the lower portion of the case. The detachable upper part of the case provides storage space for cables.

The DRA-707's power supplies are mounted in the lower portion of the case. The principal electronic circuits are attached to the front panel, which is easily removable for maintenance. All printed circuit assemblies are designed to allow convenient removal and replacement using standard electronics shop tools.

2.3 ELECTRICAL DESCRIPTION

The DRA-707 can be powered from any standard 115V or 230V, 47 to 440 Hz AC source. With the voltage selector in the 115V position, a nominal voltage of 100 VAC is sufficient to operate the unit.

With the battery option installed, the DRA-707 can operate on its own power for up to three hours. If the battery voltage drops below a pre-set level, the DRA-707 automatically reduces its power consumption (without affecting the digital word outputs) and generates a visible warning to the operator. The unit must be shut down within 15 minutes of the warning to avoid excessive discharge that would reduce the life of the internal batteries. The batteries are recharged whenever the DRA-707 is connected to the AC source, regardless of whether the unit is switched ON or OFF.

The battery pack contains eight or ten nickel-cadmium cells, depending on the serial number of the unit, and is charged by a current limited to .65 amperes by a regulator on the battery pack.

Battery voltage is monitored by a comparator circuit set to trip when the voltage at TP 7 drops to 8.75 VDC for the eight-cell battery pack and to 11.05 VDC at J6-2 for the ten-cell pack. The output of the comparator is read by a microprocessor, which blinks the LO BAT warning LED and reduces power consumption by blanking the display except for the moving decimal. The full display can be reinstated by pressing any parameter key.

NOTE

Units with serial number 001 to 032 are fitted with the eight-cell battery pack. Units with serial number 033 and above are fitted with the ten-cell battery pack.

2.4 SPECIFICATIONS

Dimensions:

Closed Case	19.5 x 9.5 x 13.5 inches (50 x 24 x 34 cm)
Upper Portion	19.5 x 9.5 x 6 inches (50 x 24 x 15 cm)
Lower Portion	19.5 x 9.5 x 7.5 inches (50 x 24 x 19 cm)

Weight (not including cables):

Without Battery Option	20 lbs (9 kg)
With Battery Option	24 lbs (11 kg)
Average Shipping	29 lbs (13 kg)

Temperature Range:

Operating	32/122°F (0°/40°C)
Storage	-58/+185°F (-50°/+85°C)

Display: Fluorescent, 20 character alphanumeric.

Operating Voltage: 115/230 VAC, 47-440 Hz

Word Characteristics: data per ARINC 707

Output Word Labels: 164 and 165

Output Characteristics:

TTL Logic Levels (data contents of ARINC 707 words)	High >2.4 v Low <0.7 v

ARINC 429 Voltage Levels:

Line A to Line B:

High	+10 ±1.0
Null	0 ±0.5
Low	-10 ±1.0

Line A to Ground:

High	+5 ±0.5
Null	0 ±0.25
Low	-5 ±0.5

Line B to Ground:

High	-5 ±0.5
Null	0 ±0.25
Low	+5 ±0.5

Bit rate = 10 - 15.0 BPS
Time Y = Z ±2.5% μs*
Time X = Y/2 ± 5% μs
Pulse Rise Time** = 10 ± 5 μs
Pulse Fall Time** = 10 ± 5 μs

* Z = 1/R, where R = bit rate selected from 10 - 15.9 BPS range

**Pulse rise and fall times are measured between the 10% and 90% voltage amplitude points on the leading and trailing edge of the pulse and include permitted time skew between the transmitter output voltages A-to-ground and B-to-ground.

RS-422 Outputs (used by ARA-552 only):

Maximum Signal Line Loads:

TTL outputs	100Ω
ARINC 429 outputs	1 kΩ
RS-422 output	100Ω

AFCS Discrete:
Max. current output 100 mA total
Switched +14 VDC.

Altitude Range:
+8000 ft. to -20 ft. with resolution of 0.125 ft. (BNR) and 0.1 ft. (BCD).

Bit Frequency Range:
10 kHz to 15.9 kHz with resolution of 0.1 kHz.

Vertical Speed Range:
+8000 fpm to -8000 fpm with a resolution of 1 fpm.

NOTE
A vertical speed range of +16,000 to -16,000 fpm is made possible by combining the VERT SPD and ERROR INCREMENT parameters.

Simulated Faults	Failed LRU No Computed Data Erroneous Altitude
Accuracy	Output bit rate and ramping rates ±0.1% (when bit change period is not less than 30 ms). Displayed values are truncated to the nearest digit for altitudes and are exact for all other parameters.

Section 3

OPERATING THE DRA-707

3.1 UNPACKING

Carefully remove the unit from its packaging materials. Open the case and ensure that the AC power cord, Remote Control Unit, battery pack, and any accessory cables that were ordered are present. Check for any physical damage that may have occurred during shipping, and report any damage immediately to the shipper and to Atlantis Aerospace Corporation.

3.2 CONTROLS AND INDICATORS

All controls and indicators are located on the front panel, shown in Figure 3-1.

Table 3-1 lists the DRA-707's controls and indicators and their functions.

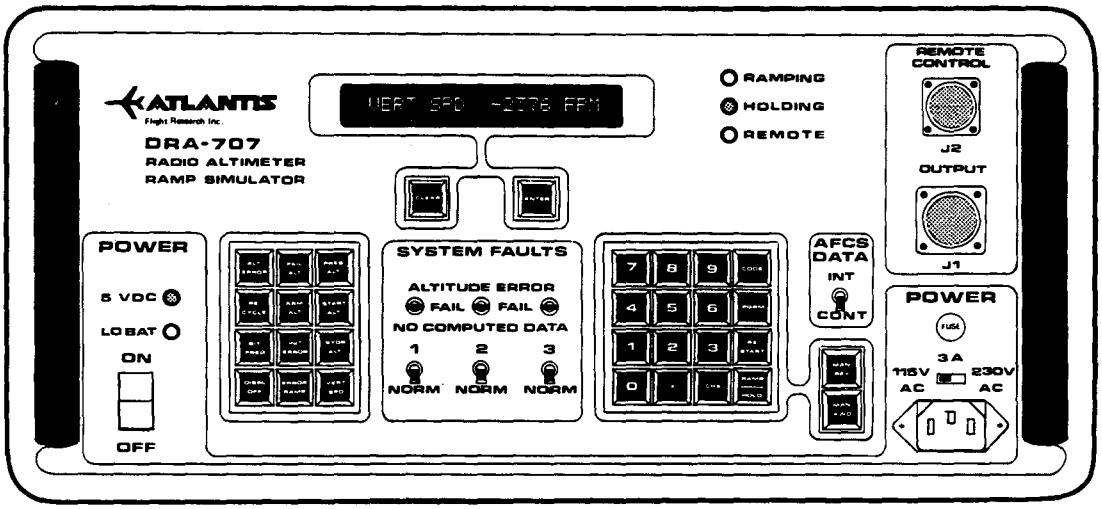


Figure 3-1. DRA-707 Front Panel

Table 3-1 DRA-707 Controls and Indicators

CONTROL	FUNCTION
POWER ON/OFF switch	Switches 5VDC operating power to the DRA-707 electronics and DC-to-DC power converters. This switch does not control battery charging power.
5VDC lamp	Indicates presence of 5-volt DC operating power.
LO BAT lamp	Indicates a low battery voltage condition which, unless corrected by applying charging power, will result in interruption of DRA-707 outputs approximately ten minutes from first occurrence due to loss of battery power. The first indication of low voltage is a steady LO BAT light. If no key is pressed within 30 seconds and the low voltage condition persists, the light will flash and the display will blank.
ALT ERROR	Displays the difference between the PRES ALT parameter and the erroneous altitude that would be transmitted if the Altitude Error fault were selected. (The value of the erroneous altitude is displayed by the FAIL ALT parameter; a positive number means FAIL ALT is above PRES ALT.) ALT ERROR does not accept keyboard entries. It only displays data.
RECYCLE	Controls the parameter that causes a descending ramp to restart automatically upon reaching the STOP ALTITUDE. (A climbing ramp can not have a recycle capability.)
BIT FREQ	Displays the data bit output transmission rate. The rate is selectable in 0.1 kHz steps over the range of 10 kHz to 15.9 kHz.
DISPL OFF	Causes the display to blank. Operation of the DRA- 707 is otherwise unaffected. This function is provided primarily to reduce the battery load. BATTERY OPTION ONLY: When the LO BAT warning is activated, this function is automatically called. Use of the display while in a low battery condition will cause loss of power in a short period of time.
FAIL ALT	Displays the value of erroneous altitude as transmitted by the DRA-707. FAIL ALT is created by the addition of an error value to the PRES ALT. This error value is determined by the parameters INIT ERROR (or initial offset) and ERR RAMP (or rate of change). The actual numeric error value can be displayed by selecting the ALT ERR key. Changes in the FAIL ALT can occur only when the ramp is progressing. Also, the FAIL ALT can only ramp (not jump) except for the two conditions when the INIT ERR is added (see INIT ERROR). For this reason it is good practice to select a RESTART to set up any ramp. The FAIL ALT parameter is for display only, and cannot be changed manually.

Table 3-1 DRA-707 Controls and Indicators (cont'd.)

CONTROL	FUNCTION
ARM ALT	Displays the altitude at which the ALT ERROR parameter will assume the value of the INIT ERROR parameter and begin changing at the ERROR RAMP rate. The ARM ALT parameter is only active in descending ramps.
INIT ERROR	Displays the value of the initial, or fixed, altitude error that will be added to the present altitude upon initiation of the Altitude Error fault. The fault of ALT ERROR will be initiated only upon two occasions: 1) When the PRES ALT descends through the ARM ALT. 2) When the ramp is restarted to a START ALT that is below the ARM ALT. The default value for INIT ERROR is zero feet.
ERROR RAMP	Displays the value of the rate of change of the ALT ERROR parameter. This ramp is added to the existing VERT SPD ramp. Thus an ERROR RAMP value numerically equal but of opposite sign to the VERT SPD parameter will cause the FAIL ALT to hold steady as the PRES ALT continues ramping.
PRES ALT	Displays the value of the PRESent ALTitude parameter. This is the data that is normally transmitted to the altimeters and represents the real height of the aircraft. NOTE: PRES ALT should not to be confused with the abbreviation for "pressure" altitude. The DRA-707 is a RADIO altimeter ramp simulator and is not concerned with the aircraft's pressure altitude. A new PRES ALT can be entered at any time by keying-in the new value and pressing ENTER. The DRA-707 output is not affected until ENTER is pressed. The FAIL ALT does not jump in relation to the change in PRES ALT. The PRES ALT displayed is truncated at the decimal point. The actual value may contain a fractional component between 0 and 0.9. This can sometimes make it appear that an event has been mis-timed by one foot. Only RAMPING can create fractional foot values.
START ALT	Displays the value at which the altitude ramp will start.

Table 3-1 DRA-707 Controls and Indicators (cont'd.)

CONTROL	FUNCTION
STOP ALT	Displays the value at which the altitude ramp will stop. Note that if the RECYCLE parameter is enabled, the ramp automatically reverts to the
STOP ALT (cont'd)	START ALT and begins a new ramp sequence unless a Recycle Sequence is in effect. In this case, the ramp will stop when the STOP ALT of the last leg is reached.
VERT SPD	Displays the vertical speed of the ramp, i.e., the rate and direction of change of the PRES ALT parameter. Negative values indicate descending ramps.
CLEAR	Clears the display of error messages and any incomplete data entered via the keypad.
ENTER	Causes the data entered into the display to be entered as the current value of the parameter. Before data is accepted, it is checked for conformity with the parameter format and numerical range limits. Numerical data that is out of range is noted and explained by an error message on the display. The error message must be cleared before proceeding.
SYSTEM FAULTS switches	For each of the three altimeter systems to which the DRA-707 may be connected there is an upper and a lower Fault Switch. The three switches in the upper row are of the three-position type: up = ALTITUDE ERROR, centre = FAIL, down = NO COMPUTED DATA. ALTITUDE ERROR: The current value of the ALT ERROR parameter is added to the value of the PRES ALT parameter before being transmitted to the corresponding Altimeter System connector (i.e., 1, 2, or 3). There is no effect other than the erroneous altitude. The erroneous altitude value can be displayed using the FAIL ALT key. FAIL: Simulates failure of the radio altimeter. The BCD word (label 165) ceases transmission. The BNR word (label 164) will continue or cease transmission according to the position of the AFCS DATA switch. SSM bits in the transmitted word are set accordingly, and the AFCS Discrete line for the affected altimeter (normally at +14VDC) is pulled to a logic low state. NO COMPUTED DATA: Causes the SSM bits of the transmitted words to be set accordingly. Data contained in the words is fixed at the maximum value of 8000 ft (BNR) and 7999.9 ft (BCD).

Table 3-1 DRA-707 Controls and Indicators (cont'd.)

CONTROL	FUNCTION
SYSTEM FAULTS switches (cont'd)	The three switches in the lower row are of the two-position type: up = 1, 2, or 3 (the number of the corresponding altimeter), and down = NORM. In the up position, all selected faults are active and sent to the corresponding altimeter. The down (NORM) position provides normal operation of the altimeter, regardless of any faults selected.
RAMPING lamp	Indicates that the ramp is progressing.
HOLDING lamp	Indicates that the ramp has halted. Output transmission continues (unless the FAIL fault is selected as above).
REMOTE lamp	Indicates that the faults are controlled remotely, and not by the front panel switches. All momentary key functions on the front panel remain active.
0-9 and decimal pt.	Pressing any of these keys causes the appropriate value to be written to the display
CHS	Used to CHange the Sign or sense of data on the display or to alter the status of two-state parameters (e.g. Recycle Disabled/Enabled).
CODE	Followed by a digit, used to select maintenance and utility functions. The CODE functions are intended for use by technicians in the maintenance of the DRA-707. To avoid possible disruption of parameter values, they should be avoided during flight line testing. CODE 1 - DIAGNOSTIC: Display indicates the reception of keypad and discrete switches. Each keypad switch selection (including the Remote Control Unit) causes the SCAN/RETURN code of that switch to be updated on the right side of the display. The four digits in the centre of the display represent the AFCS DATA and Systems 1, 2, and 3 Fault Switch matrices, in that order. The display is updated only upon a keypad selection. Therefore, after making a fault selection, a key must be pressed to update the display. The two fault switches for each system are configured into an effective four-position switch with NORM being '0', ALTITUDE ERROR being '1', NO COMPUTED DATA being '2', and FAIL being '3'. The inputs have no effect on the output of the DRA-707 while it is in the DIAGNOSTIC mode. The CLEAR key must be pressed twice consecutively to exit this mode.

Table 3-1 DRA-707 Controls and Indicators (cont'd.)

CONTROL	FUNCTION
CODE (cont'd)	CODE 2 - SYSTEM RESET: Causes the program to re-initialize. Cycling the power switch has the same effect. CODE 3 - INITIALIZE EEPROM: Initializes a blank EEPROM with the default parameter set in PGRM 0. Other than by using this coded function, it is not possible to write a parameter set into PGRM 0. CODES 4 AND 5 - FUNCTIONAL TEST INHIBIT: DRA-707s equipped with software versions 3.0F or higher can simulate the toggling of the Functional Test Inhibit bit, bit 11 of the binary word (label 164), using the following code functions: CODE 4 - SET FUNCTIONAL TEST INHIBIT: Sets bit 11 of the binary word to a "1" to indicate that the Functional Test feature of the radar altimeter is inhibited. The display shows: **FUNCT TEST INHIB** CODE 5 - CLEAR FUNCTIONAL TEST INHIBIT: Sets bit 11 of the binary word to a "0" to indicate that the Functional Test feature is not inhibited. The display shows: **FUNCT TEST NOT INHIB** On power up, the Functional Test feature is in the "not inhibited" state. Otherwise, it remains in the state which was selected last.
PGRM	Provides the ability to permanently store and retrieve parameter sets using the Program Store and Program Recall functions as described in paragraph 3.4.2.2.
RESTART	Sets the PRES ALT equal to the START ALT and resets the errors. When a Recycle Sequence is active, RESTART reverts to the first ramp listed in the sequence. The key must be depressed twice consecutively to cause a restart.
RAMP/HOLD	Causes the programmed altitude ramp to proceed and hold on alternate key selections.

Table 3-1 DRA-707 Controls and Indicators (cont'd.)

CONTROL	FUNCTION
MAN FWD/ MAN REV	(Active only when the ramp is holding.) MAN FWD causes the ramp to proceed normally as long as the key is depressed. MAN REV causes the ramp and associated errors to move in the exact reverse fashion to the normal ramp. When a Recycle Sequence is active, the ramp moves in reverse only within the current leg. It will not transfer to another leg.
AFCS switch	INTerrupted position causes the BNR word of the affected system to cease transmission when the fault of FAIL is selected. CONTininous position causes the BNR word to continue transmission with proper altitude data present, but the SSM bits set accordingly. The BCD word ceases transmission when FAIL is selected, regardless of this switch position.
POWER FUSE	Provides protection against a short-circuit in the power transformer primary circuit. A 2 ampere fuse is correct for both the 115V and 230 VAC settings. (Fuses in the secondary power circuits provide protection against potential overload conditions.)
115V/230 VAC switch	Selects the correct power transformer primary for the AC source voltage. Power frequencies of 47 to 440 Hz are acceptable.
	CAUTION Select the proper voltage before connecting power, even if the power ON/OFF switch is OFF. The transformer primary is powered directly, not through the ON/OFF switch.

3.3 CONNECTORS

Table 3-2 lists the DRA-707's connectors.

Table 3-2 DRA-707 Connectors

CONNECTOR	FUNCTION
OUTPUT (J1)	Provides output signals for three radio altimeter connector systems. Each system's signals include the TTL-level 0 and 1 pair plus AFCS discrete line and ground required to interface to a Collins LRA-700 radio altimeter, plus a standard ARINC 429 bus pair to drive the aircraft bus directly with the altimeter removed. The information contained in the two signal sets (i.e., altimeter and aircraft bus) is identical. In addition, there are two RS-422 line drivers that send the BNR data from all three systems as 1's and 0's for use by the Analogue Adapter.
REMOTE CONTROL (J2)	Provides connection to the Remote Control Unit (supplied). User control over fault selection can be achieved with contact closures through this connector. The functions of RAMP/HOLD, MAN FWD, MAN REV, RESTART, CLEAR, PRES ALT (display only), ALT ERROR (display only), and DISPLAY OFF are controllable using momentary contact closures of at least 50 ms duration. Fault selections are made by closing the contact(s) for the desired duration of the fault effect. Discretes (active low, TTL levels) are presented at this connector to indicate RAMPING, HOLDING, and LOW BATTERY states. Refer to the wiring diagrams in the Maintenance Section.
POWER	Accepts a standard international (IEC) three-pin AC power connector as fitted on the power cord supplied with the unit.

3.4 OPERATING INSTRUCTIONS

3.4.1 Basic Set-up

The DRA-707 should be placed where convenient for the operator. The Remote Control Unit may be used for control over the ramp and faults from a distance of up to about 10 feet. Any data entry, however, must be done via the DRA-707 front panel keypads.

Connect the DRA-707 to the front-panel test connector of the LRA-700 radio altimeter(s) in the aircraft's avionics rack using the triplex cable supplied. This cable can be extended using the extension cable available as an accessory.

If the DRA-707 is to be externally powered, ensure that the POWER voltage selector switch on the right-hand side of the front panel is set to the correct voltage, and connect the power cord to a suitable source of AC power.

Turn the POWER ON/OFF switch on the left-hand side of the panel ON. The 5VDC indicator lamp will light.

If external power is not available, the DRA-707 can operate on its own internal batteries for up to three hours. To use internal power, disconnect the AC power cord from the DRA-707. Turn the POWER ON/OFF switch to ON. The 5VDC indicator lamp will light. If the LO BATT indicator lights, the batteries must be recharged before the DRA-707 can be used without line power. To conserve the batteries, we recommended that the DRA-707 be turned off when not required for testing.

The DRA-707 batteries will recharge whenever the unit is connected to a source of external power, regardless of whether the unit is switched ON or OFF. They are charged by a constant current regulator and will not be damaged by extended periods of charging.

CAUTION

> The batteries may be damaged by an excessive discharge. It is advisable to use external power whenever feasible, and to recharge (just plug in) the DRA-707 for at least three hours following the use of battery power. Full recharge from any state takes a maximum of 17 hours.

Figure 3-2 shows the basic physical connections to the aircraft. Refer to the applicable manufacturer's manuals for details of the specific interconnections required for the tests to be performed.

3.4.2 Entering Ramp Parameters

Once the connections to the aircraft have been made, the ramp parameters required for the test to be performed must be entered. This can be done manually by entering pre-calculated values for each parameter (see paragraph 3.4.2.1), or automatically using the Program Recall function (see paragraph 3.4.2.2).

A sample calculation of ramp parameters is given in paragraph 3.4.5.

The basis of the altitude ramp is the Present Altitude (PRES ALT) parameter. This may be thought of as the true height of the aircraft, regardless of the indications of failed or erroneous altimeters. All three altimeter systems use PRES ALT as a reference.

A normal ramp has a start altitude (START ALT), stop altitude (STOP ALT), and a vertical speed (VERT SPD). Refer to Table 3-3 for the ranges and default values of these parameters. (The default values are those that are automatically inserted by the DRA-707 during the power-on and Reset procedures.)

The altitude ramp will progress from the PRES ALT to the STOP ALT at a rate defined by the VERT SPD. If it is desired to have the ramp repeat automatically, the Recycle Sequence Mode, described in paragraph 3.4.3, may be used. In this case, when the STOP ALT is reached, the PRES ALT is automatically made equal to the START ALT, the faults are reset, and the ramp, in effect, begins all over again. Up to three separate ramps may be run sequentially and automatically by using the Recycle Sequence Mode.

3.4.2.1 Manual Entry of Parameters

As mentioned above, before using the DRA-707, the ramp parameters required for the aircraft test must be entered.

The desired ramp is created by entering the desired START ALT, STOP ALT, and VERT SPD. Errors may be added to the basic ramp to cause one or more of the altimeters to vary from the PRES (present or true) ALT.

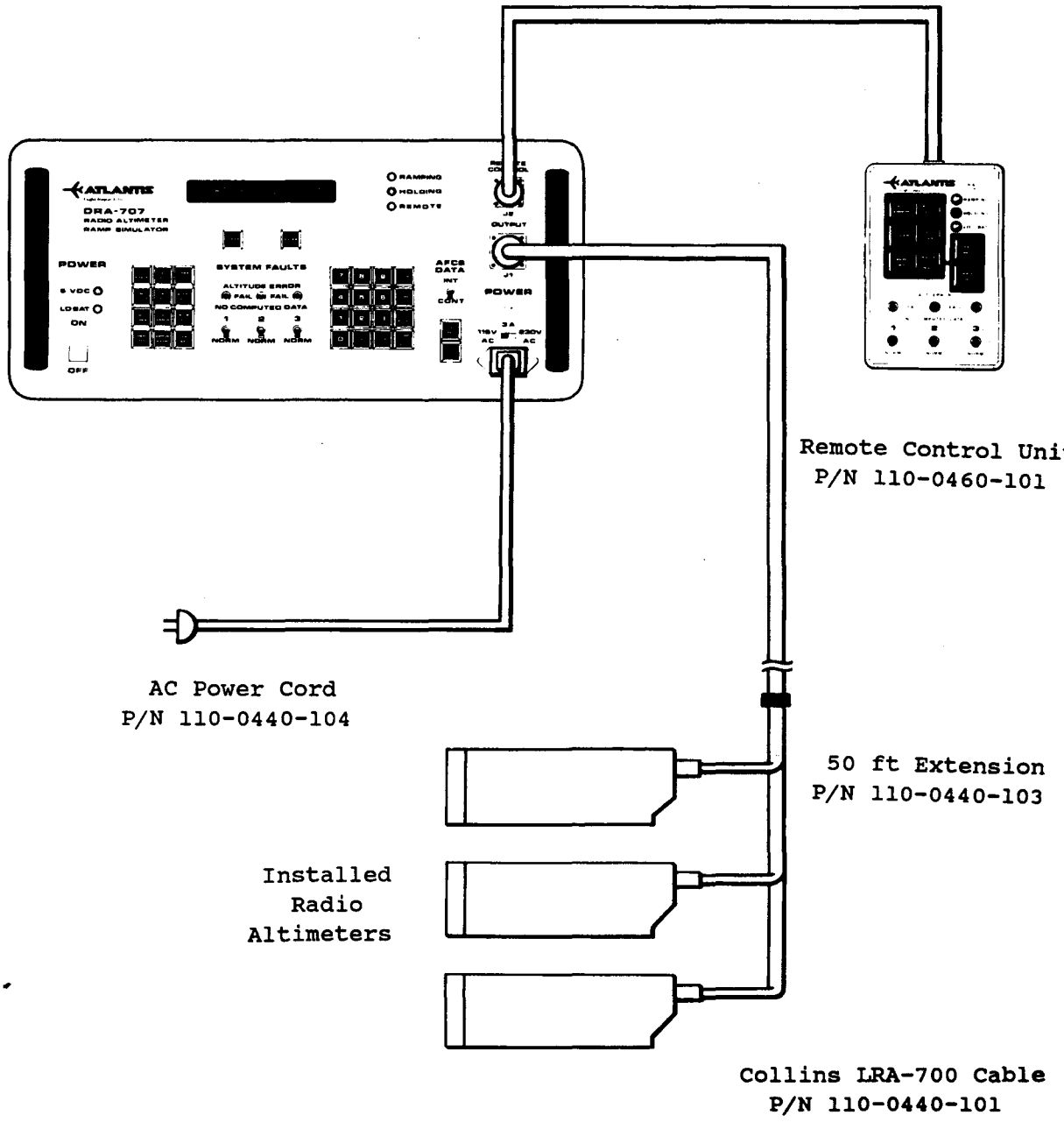


Figure 3-2 DRA-707 Basic Interconnection Set-up

Table 3-3 Ranges, Resolutions, and Default Values

PARAMETER	RANGE	RESOLUTION	DEFAULT VALUE
BIT FREQ	10 to 15.9 kHz	0.1 kHz	12.5 kHz
START ALT	+8000 to -20 ft	1 ft	2500 ft
STOP ALT	+8000 to -20 ft	1 ft	-20 ft
PRES ALT	+8000 to -20 ft	1 ft	2500 ft
VERT SPD	+8000 to -8000 fpm	1 fpm	-500 fpm
INIT ERROR	+8000 to -8000 ft	1 ft	0 ft
ERROR RAMP	+8000 to -8000 fpm	1 fpm	0 fpm
ARM ALT	+8000 to -20 ft	1 ft	8000 ft

Table 3-4 DRA-707 Error Parameters and Controls

PARAMETER/CONTROL	FUNCTION
ALT ERROR parameter	Displays the differences between PRES ALT and the FAIL (erroneous) ALT. This parameter is for display purposes only and cannot be altered manually.
ERROR RAMP parameter	Contains the value of the rate at which the ALT ERROR will increase (or decrease). In a descending ramp, the error is active below the ARM ALT. In a climbing ramp, the error is active when selected.
ARM ALT parameter	The altitude at which the ALT ERROR will take effect. The "erroneous altitude" thus initiated will ramp regardless of altimeter fault selections, and any altimeter for which the ALTITUDE ERROR fault is selected will copy this ramp. **NOTE:** Where descending ramps are to start below the set ARM ALT, the errors will behave as if the ARM ALT were the START ALT.
NORM switches	The related altimeter system altitude output tracks the PRES ALT value. If moved out of NORM position, the fault selected by the switch immediately above will affect that altimeter system as follows: NO COMPUTED DATA: The altimeter output will set the SSM bits of the word accordingly, and will transmit the fixed full range altitude of 8000 (BNR) and 7999.9 ft (BCD).

Table 3-4 DRA-707 Error Parameters and Controls

PARAMETER/CONTROL	FUNCTION
	FAIL: The BCD output word will cease and, if the AFCS switch is set to CONTinuous position, the BNR word will continue to be transmitted with the SSM bits set accordingly. If the AFCS switch is in the INTerrupted position, the BNR word will also cease to be transmitted. Additionally, the associated AFCS discrete (normally at +14 VDC) will go to 0.4 VDC. ALTITUDE ERROR: The PRES ALT crossing the ARM ALT in a descending ramp will cause the ALT ERROR to begin increasing at the rate specified by the ERROR RAMP. The ALT ERROR is added to the PRES ALT, and this erroneous altitude will be transmitted by any altimeter having the fault selected. There is no setting of the SSM bits or discretes. The FAIL ALT parameter displays the sum of PRES ALT plus ALT ERROR.
INIT ERROR parameter	This parameter displays the value of the offset which will be immediately added to the PRES ALT when an altimeter system fault of ALTITUDE ERROR is selected. The parameter cannot be manually altered.

Figure 3-3 shows a typical ramp with some faults and errors.

To view the current value of each ramp parameter on the DRA-707's display, press the corresponding key or code. To change the value of a parameter, enter the desired numeric data while the parameter in question is displayed. Refer back to Table 3-1 for specific information on entry of information using the keypad.

Error parameters and controls are described in Table 3-4.

3.4.2.2 Program Recall Function

To use the Program Recall function to set pre-calculated ramp parameters for a test, the desired parameter values must be stored in the DRA-707 prior to its use on the flight line. When the test is to be run, the program number under which the parameters for the test were stored is supplied to the flight line technician, who can then set the ramp parameters for the test using only three keystrokes, thus minimizing the possibility of error.

The only six parameters that can be stored and recalled are START ALT, STOP ALT, VERT SPD, ARM ALT, INIT ERROR, and ERROR RAMP.

TO STORE PARAMETERS: Press the PRGM key once. Then enter the desired parameters as described in paragraph 3.4.2.1. When all desired parameters have been entered, press the PGRM key twice. The display then requests the number under which the parameters are to be stored with the message "SAVE RAMP PROGRAM". Enter a number between 1 and 99 by pressing the desired number key(s), followed by ENTER. The display responds with "**SAVING PROGRAM**" while the parameters are being stored, followed by "READY".

Ramp Programs Nos. 97, 98, and 99 are factory-set for a demonstration of the Sample Ramp Calculation (see paragraph 3.4.5). They can be overwritten if desired.

Documentation of the stored ramps is an administrative responsibility of the user. It is highly recommended that all ramps and parameters be kept well documented so that this data can be conveniently re-entered should the EEPROM require replacement. (A stored program record sheet is provided in Appendix 1)

TO RECALL: To recall a program for use in a test, press the PRGM key once. The display requests the number of the desired ramp program with the message "RECALL RAMP

PROGRAM". Key in the number of the desired program and press ENTER. The display responds with the message "READY". The DRA-707 is now set with the desired parameter values.

3.4.3 Recycle Sequence Mode

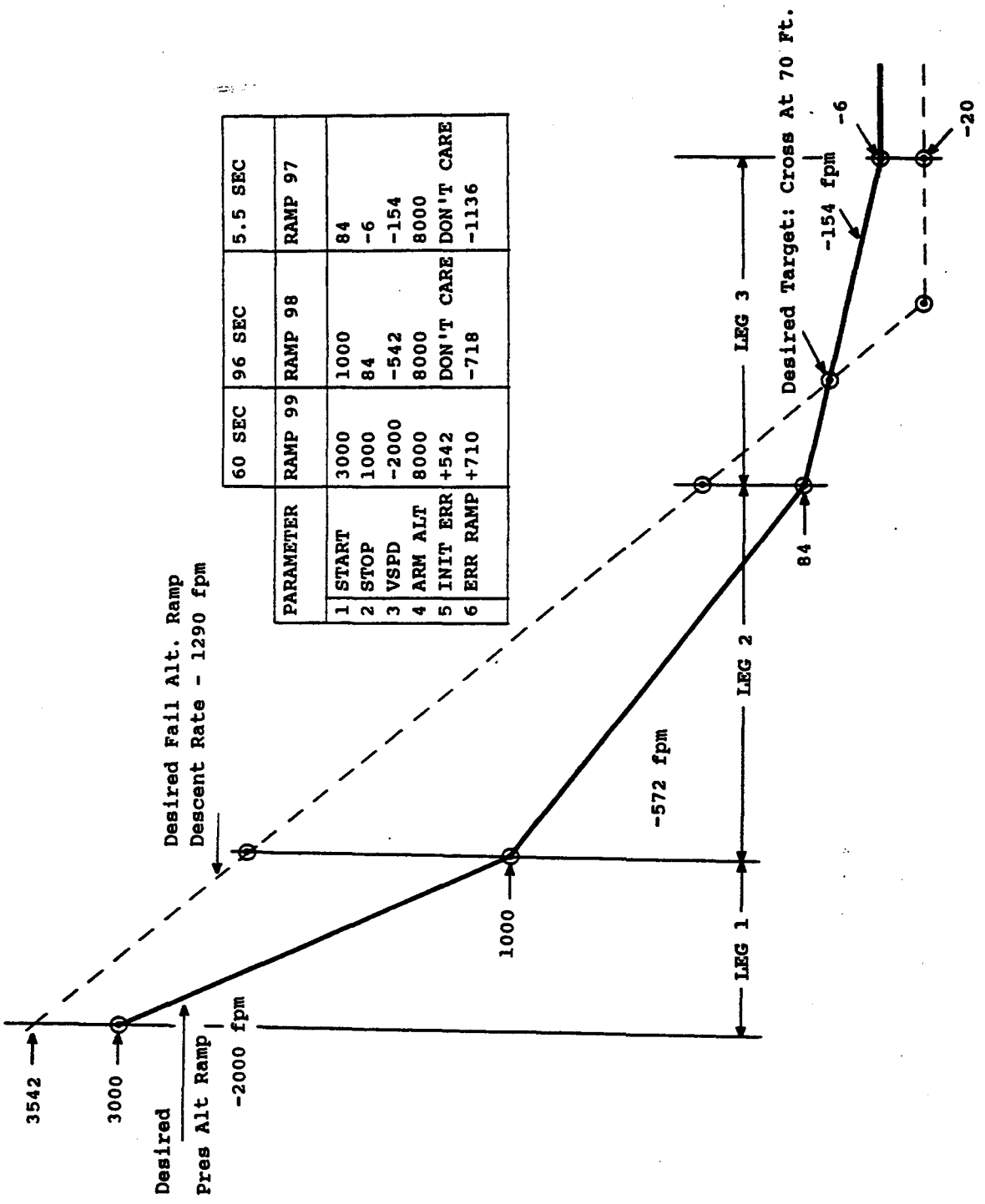
In the Recycle Mode, a descending ramp restarts automatically upon reaching the STOP ALTITUDE. (A climbing ramp can not have a recycle capability.) A special feature is the ability to call up to three ramps in sequence automatically, to simulate a flight profile with varying descent rates. The ramps are called from those stored by the operator (see paragraph 3.4.2.2), and the mode of operation is called the Recycle Sequence Mode. The Recycle Sequence mode is entered by selecting the ramp program that will become the first, or starting leg of the descent sequence (by keying-in the program number followed by ENTER). Two more programs may be keyed in (separated by decimal points and followed with ENTER) to designate the chosen sequence of ramps. When the desired program numbers for the sequence have been entered, press RESTART to send the DRA-707 to the start of the first ramp in the sequence.

The sequence will be remembered by the DRA-707 until a new sequence is entered, the Recycle Sequence Mode is disabled, or power is turned off. The recycle enabled and disabled states are selected using the CHS key. The power-on condition is recycle disabled.

While in the Recycle Sequence Mode, the ramps will not automatically recycle upon reaching the STOP ALT of the last ramp. The MAN FWD/MAN REV keys will permit movement only within the existing leg (they will not jump across to the adjacent leg segment.) A sample calculation of a Recycle Sequence is given in the Sample Ramp Calculation.

3.4.4 Error Messages

Various error messages may appear on the display from time to time. Table 3-5 explains their meanings.



	PARAMETER	60 SEC RAMP 99	96 SEC RAMP 98	5.5 SEC RAMP 97
1	START	3000	1000	84
2	STOP	1000	84	-6
3	VSPD	-2000	-542	-154
4	ARM ALT	8000	8000	8000
5	INIT ERR	+542	DON'T CARE	DON'T CARE
6	ERR RAMP	+710	-718	-1136

Figure 3-3 Typical Ramp

3.4.5 Sample Ramp Calculation

Single ramp calculations are quite simple to calculate by observing the mathematical relationship of distance, rate, and time. An element of complexity is added to these relationships, however, when calculating the start and stop points of three concatenated ramps using the Recycle Sequence feature.

Each ramp of the three-ramp sequence depicted in Figure 3-3 has been programmed into the DRA-707 at the factory to demonstrate this feature. (If so desired, Ramp Program Numbers 97, 98 and 99 can be overwritten and would, in that case, not apply to the following example.)

This sample ramp will generate a descent profile where the PRES ALT assumes a different VERT SPD in each of the three legs, but the FAIL ALT maintains a steady descent rate from its initial position of 3542 ft to the ARINC limit of -20 ft, crossing the PRES ALT at 70 feet.

The PRES ALT will start at 3000 ft, descend to 1000 ft at 2000 fpm, and descend from there to 84 ft at 572 fpm. (This example is for demonstration purposes only. It bears no relation to a real application.)

The following steps and facts are presented to assist in understanding the process of ramp calculations.

1) The PRES ALT ramp is the parameter by which all events are timed. Therefore a vertical speed that exhibits at least a 10 foot change over the desired time period is recommended as a minimum value. Climbing ramps are not permitted since they will not recycle.

2) Any three ramps can be joined together by the Recycle Sequence feature; it does not guarantee smooth crossovers. The purpose of the calculation is to keep the transition "bumps" to less than one foot.

3) If the FAIL ALT parameter (simulating an altimeter with an erroneous output but otherwise serviceable) is not to be used, the three ramps are simply entered using the STOP ALT of the previous ramp as the START ALT of the upcoming ramp, and setting VERT SPD as desired.

4) For this example, it is desired to generate a smoothly descending FAIL ALT starting at 3542 ft and crossing the PRES ALT at 70 ft, while the PRES ALT varies its descent rate.

5) Ramp timing must first be calculated. The first leg (Ramp Program 99) descends 2000 ft at 2000 fpm and so will take 60 seconds to complete (2000ft/2000fpm = 1 minute, 1 minute x 60 sec/min = 60 seconds).

   The second leg (Ramp Program 98) descends 916 ft at 572 fpm and takes up 916/572 x 60 = 96 seconds. The third leg (Ramp Program 97) descends from 84 ft to our target crossover point of 70 ft at 154 fpm and so takes [(84-70)/154]x60 = 5.5 seconds.

   Thus the desired descent rate for the FAIL ALT can now be calculated as (3542-70)ft/(60+96+5.5)sec = 21.5 fps = 1290 fpm.

6) The next step is to "build" the FAIL ALT descent rate into each of the three legs. Remember that the descent rate of the FAIL ALT is determined by the value of the ERR RAMP adding to the VERT SPD parameter. Thus leg 1 ERR RAMP is entered as:

(-1290) - (-2000) = +710 fpm. Similarly leg 2 is (-1290) - (-572) = -713 fpm, and leg 3 is (-1290) - (-154) = -1136 fpm.

7) The DRA-707 maintains the value of the FAIL ALT when changing legs. This feature avoids the necessity for calculating the INIT ERROR offset for every leg of the sequence. (Remember that the INIT ERR parameter will only be invoked when the PRES ALT descends through the ARM ALT, or when it is restarted to an altitude that is below the ARM ALT.) Thus the starting point for the FAIL ALT is set by entering +542 into the INIT ERROR parameter of leg 1. The INIT ERROR parameters of subsequent legs have no effect.

   The previously calculated FAIL ALT descent rate will cause the FAIL ALT to head down towards -20 ft at -1290 fpm and pass through 70 ft at the same time as the PRES ALT reaches 70 ft. (The target crossing altitude at 70 ft may not be precisely achieved due to rounding errors in the calculations, incremental adjustments during leg changes, and the step size of the digital word output.)

8) The ramp stops when the PRES ALT reaches its STOP ALT. Thus if the FAIL ALT is above the PRES ALT at that time it will appear to stop in mid-air.

9) To set up the DRA-707, the six parameters for each of the legs must be saved. In this example, the factory has saved leg 1 as "RAMP PGRM 99", leg 2 as "RAMP PGRM 98", and leg 3 as "RAMP PGRM 97". (See paragraph 3.4.2.2 for details on the Program Store and Recall functions.)

10) To invoke the Recycle Sequence functions, press the following keys in sequence:

RECYCLE	(observe that Recycle is disabled.)
CHS	(to enable Recycle)
9	(the first digit of the first program number. Observe that the display now reads "RECYCL SEQ .9" with the legend flashing.)
9.	(the second digit of the first program number, followed by a period)
98.	(the second program number, followed by a period)
97	(the third program number)
ENTER	(observe that the display now reads "RECYCL SEQ .99.98 .97" and is steady.)
RESTART	
RESTART	(again)

k) The DRA-707 will now operate as normal but will execute these three ramps in sequence automatically and invisibly.

Table 3-5 DRA-707 Error Messages

MESSAGE	MEANING
-20 to 8000 FT	Out-of-range message. Appears when a value which is outside the acceptable range is keyed into the display. This applies to START ALT, STOP ALT, PRES ALT, and ARM ALT.
8000 to -8000FPM	Out-of-range message. Appears when a value which is outside the acceptable range is keyed into the display for the parameters VERT SPD and ERROR RAMP.
-8000 to 8000 FT	Out-of-range message. Appears when a value which is outside the acceptable range is keyed into the display for the INIT ERROR parameter.
10 to 15.9 KHZ	Out-of-range message. Appears when a value outside the acceptable range is keyed into the display for the BIT FREQ parameter.
EXPECTING ENTER	Appears when a key other than "ENTER" is pressed following numeric data. This message indicates that the previously keyed data has not affected the parameter in question. The normal procedure would be either ENTER the desired data, or CLEAR unwanted data from the display prior to proceeding.
READY	Appears after an error message has been cleared, or at any time that the display is awaiting selection of a parameter.
ERROR	Appears when keys are pressed out of sequence, e.g., attempting to enter data when no parameter has been selected.
WRONG RAMP DIRECTION	Appears when a ramp is attempted where the VERT SPD is of the wrong sign (= or -) to reach the STOP ALT. This error message will only be displayed when the ramp is activated, and not as the data is entered.
UNKNOWN CODE	Appears when the number following a code is not recognized by the DRA-707.
ALREADY RAMPING	Appears when a manual slew is attempted while the program is ramping.
READ ONLY PARAMETER	Appears when the operator attempts to enter data for a parameter which cannot be manually altered. The two parameters concerned are ALT ERROR and FAIL ALT.

Table 3-5 DRA-707 Error Messages (cont'd)

MESSAGE	MEANING
NO PROGRAM	Warns the user that the recalled parameter set is non-existent and that the previous parameters are unchanged.
PROGRAM RANGE - 0-99	Appears when a program number greater than 99 is selected.
SUM CHECK ERROR	Appears on power-up if contents of PROMS have changed from the original contents. Both PROMS (U11 and U12) must be replaced.
3 PROGRAMS EACH 0-99	Appears if attempt is made to enter more than three legs in the Recycle Sequence mode.
NO RAMP TO ENTER	Appears in the Recycle Sequence mode when the decimal point is pressed before specifying a ramp program number.